

Biomaterials Deconstruction & Composition Laboratory

Using customized Instron load analysis equipment, scientists and engineers evaluate the mechanical properties and fracture behavior of biomaterials to identify types and varieties of feedstocks with improved collection, handling, and preprocessing characteristics for DOE's Office of Biomass Programs support of an emerging bioenergy industry.



Purpose

Biomaterials by their very nature are complex composite structures made up of several different subcomponents whose properties are determined from the chemical configurations of the carbohydrate and lignin components. Understanding the chemical and mechanical properties of these composite structures provides the analytical support to the other signature areas in the development of computational engineering and post-harvest characterization methods and for preprocessing and feedstock assembly requirements. The BDCL utilizes microscopy, imaging systems, NIR analysis, and mechanical testing methods to characterize biomaterials. The analyses are designed to support the development of advanced composite theories and enhance harvesting, preprocessing, and pretreatment operations.

Research Goals

The biomass often has unique characteristics that may require the modification of standard testing equipment to produce reliable measurements of mechanical properties. It is the goal of this research to develop reliable methods, accurately examine and test biomass for its composition and mechanical characteristics, and determine key relationships between composition and structure to optimize quality for downstream pretreatment and processing.

Critical Linkages

The methods and tools developed through this feedstock/sugar interface R&D will link feedstock costs, quality, and sustainability metrics of harvesting, preprocessing, bulk handling, and storage systems to downstream pretreatment, hydrolysis, and fermentation operations. The R&D is guided by the program goal (C Level Milestone) of producing 300 million tons of cellulosic feedstock per year by 2010 with a 50% cost reduction compared to current technologies baselined in FY03.

Science



For more informationManagement contact:

J. Richard Hess
 Bioenergy Initiative
 2008.526.0115
JRichard.Hess@inl.gov

Project Leads:

Chris Wright
 2008.526.3075
Christopher.Wright@inl.gov

Pete Pryfogle
 2008.526.0373
Peter.Pryfogle@inl.gov

Corey Radtke
 2008.526.5186
Corey.Radtke@inl.gov

Laboratory Personnel

The program is supported by a technical staff with varied backgrounds and capabilities, comparable to no other program of its kind. Chris Wright, Pete Pryfogle, (shown in cover image) and Corey Radtke are the project leads and technical experts. Chris Wright has a theoretical and experimental background in composite structures and solid mechanics testing. Pete Pryfogle is an expert in advanced microscopy, image enhancement, and plant physiology. Corey Radtke's expertise is in organic chemistry, compositional analysis, and hydrolysis and fermentation techniques. Along with support staff and collaborating partners, the BDCL team is addressing key bioenergy technical barriers captured in DOE Office of Biomass Programs' goals and milestones.

Laboratory Capabilities and Equipment**Key Capabilities:**

- Advanced microscopy and image enhancement
- Mechanical stress/strain analysis
- Particle sizing, density measurement, separation, and classification
- NIR rapid analysis of biomass composition
- Quantitative Saccharification wet chemistry analysis

Speciality Equipment:

- 3-color laser confocal microscopy system
- Nikon E800/E600 light microscopes equipped with
 - DIC (differential interference contrast) polarization
 - Phase contrast and dark field
 - Epifluorescence – numerous wavelength excitation and emission spectra
- Environmental scanning electron microscope
- FOS NIR forage analyzer
- Leica RM2145 RC microtome
- Still and video imaging systems
- Image Pro Plus and Photoshop Adobe image analysis software
- Instron universal stress/strain load frame
- TA Instruments – Q800 Dynamic Non-contact Mechanical Analysis Instrument

Supporting Personnel

The project is supported by skilled personnel in material science, fracture mechanics, agricultural systems design, plant science, microbiology, and high speed imaging. These personnel include Richard Hess, Reed Hoskinson, Pete Pryfogle, Eric Steffler, Richard Williamson, Jeff Lacey, Mike Daniels, and Brad Blackwelder of the INL.

Publications

C.T. Wright, P.A. Pryfogle, N.A. Stevens, E.D. Steffler, J.R. Hess, and T.H. Ulrich. 2004. Biomechanics of Wheat/Barley Straw and Corn Stover. *The 26th Symposium of Biotechnology for Fuels and Chemicals held in Chattanooga, TN. May 9-12, 2004.*

K.D. Hamman, R.L. Williamson, E.D. Steffler, C.T. Wright, J.R. Hess, and P.A. Pryfogle. 2004. Structural Analysis of Wheat Stems. *The 26th Symposium of Biotechnology for Fuels and Chemicals held in Chattanooga, TN. May 9-12, 2004.*

